ENGINEERING EDUCATION

Bulletin of the

Society for the Promotion of Engineering Education

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Chas. F. Scott, Mortimer E. Cooley, F. L. Bishop, *Editor*

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OUR NEXT CONVENTION.

BY C. F. SCOTT,
President, S. P. E. E.

Our next Convention will be held at the University of Illinois from June 20 to 23. Meetings of teachers of engineering for interchange of ideas was the original object in the minds of those who formed the Society. The formal meetings and the informal discussions and the pleasant acquaintances formed at the annual Conventions for nearly thirty years have been large factors in the life of the Society.

Meetings of a few days attended by 10 or 15 per cent. of our members, valuable and indispensable as they may be, do not meet the whole needs of engineering teachers. Frequent meetings of Branches in each institution participated in, not only by our own members, but by as many others dealing directly and intimately with the problems of the individual teacher, the individual department and the individual institution, have possibilities for livening and advancing engineering teaching which the annual meeting does not possess. The professional engineering societies have in their sections and branches developed society activity and vitality which bring together the bulk of the membership in frequent meetings and have developed activities and a strength which supplements the annual convention. Likewise, our Society will have tremendously increased influence and power when its branches and sections, active throughout the year, bring new interest and purpose to the annual convention.

The topic at the next convention is "How to Teach." It is proposed that at several of the sessions there shall be a particular topic introduced by a few keynote papers, followed by prepared discussions and closing with general discussion. At the joint meeting with the American Society of

Mechanical Engineers in December, "Professional Education for the Industries" was presented by four principal speakers followed by five-minute discussions by a dozen or more who had been invited to participate. Any of these discussions might easily have occupied fifteen minutes but when condensed there was presented the essence of the matter and the best ideas of many men. This will be an admirable plan to follow at our annual convention.

The program of the meeting is as yet tentative. The following proposals are under consideration.

1. How Engineering is taught at the University of Illinois; inspection of laboratories and equipment, presentation of unique methods.

2. The Project Method; what it is, where it is applicable, instances of results obtained.

3. Psychological tests to determine aptitudes of students; presentation and discussion of the need, the progress made, the results obtained.

4. Measurement of Student Attainment in Engineering Education. Presentation and discussion of the need, the methods proposed and the results obtained.

5. How to Teach. Address by an educational psychologist. General discussion.

6. S. P. E. E. Branches; theory and practice. What is their place in our engineering schools—what they should accomplish—what they have accomplished—how can they be made more serviceable?

It is expected that a minimum time will be allotted to the reading of papers and reports and a maximum time for short discussions by many members. Members and Branches are invited to offer comment on the foregoing schedule, to make suggestions and to propose the names of men who may be invited to contribute certain papers or snappy discussions on the foregoing topics.

Please send such reports promptly to the Secretary, preferably with carbon copy to the President.

OUR NEXT CONVENTION.

Probably all of us can recollect misread papers at Conventions. Misread because they ought not to have been read. Sometimes an active discussion is abruptly stopped when it is at its peak of enthusiasm in order that some paper or report in which nobody is particularly interested can be read filling all the time to adjournment, although already in printed form in the hands of the members and could be just as well read next week or next month (or never). I recall a catastrophe of this kind at an S. P. E. E. meeting. A member did not respond to the dictates of common sense, propriety nor the admonitions of the Chair but insisted on reading the details of a long paper in which there was little interest and the most lasting impression conveyed was the attempt at personal publicity.

Let us have keynote master papers with rapid-fire discussion that hits the mark. Don't forget to do your part at once by contributing ideas and names as above suggested.

Make your plans to come to the meeting.

WHO SHOULD INSTRUCT ENGINEERING STUDENTS IN NON–ENGINEERING SUBJECTS?

Should the instruction in mathematics, English, etc., be given under the supervision of the engineering faculty or not? Do instructors in English lose caste in their own departments if they merely teach engineering students?

To answer these questions a letter was sent by the President of the Society to a number of university presidents. Many replies have been received. These replies cover a broader scope than a simple answer to specific questions. They deal with fundamental questions of engineering educational policy. They indicate that the best solution of a certain problem in one institution is different from that in another operating under other conditions.

The letter and extracts from replies follow:

September 8, 1921.

Dear Sir: As incoming President of the Society I am taking up various matters of general policy and among them the importance of membership in the Society by teachers of engineering students in such departments as Mathematics, Physics, Chemistry and English. The more clearly all teachers appreciate the objects and ideals to be attained in engineering teaching, the more interested and effective they will be in realizing these ideals in their work.

Th Society has inaugurated a movement for local meetings for the discussion of engineering teaching in various institutions. The effectiveness of such meetings wll be greatly promoted if all instructors of engineering students participate.

The Chairmen of our standing committees on Mathematics, English, etc., are being asked to contribute to our October BULLETIN stating why instructors in their respective departments should be members of the Society.

We recognize the very great importance of these non-technical fundamental subjects to the engineer and it is certainly one of the functions of our Society to improve and strengthen

the instruction in them. However, the point has been raised that if special interest in engineering is manifested by an instructor in another department, such as English, he will lose caste in his own department and this operates against his advancement. If this is true we are confronted by a serious condition.

One solution of this difficulty is to have instructors in these subjects under the direction of the Faculty of the Engineering School.

I am asking you, as a University President, if you will express your view briefly on the following question:

Is it advisable to have the instruction in mathematics, English, etc., given under the supervision of the Engineering Faculty in order to obtain better instruction in these subjects for engineering students?

It is proposed to publish a summary of the replies in ENGINEERING EDUCATION, the monthly Bulletin of the Society.

Very truly yours,
(Signed) CHAS. F. SCOTT,
President.

EXTRACTS FROM REPLIES.

Lehigh University.

I see no reason why a special interest in the problems of teaching some subject such as English to engineering students should militate against the recognition or promotion of an instructor. On the other hand, he should have special commendation and recognition. I am personally of the opinion that the advantage of centralizing all work in a particular subject in one department is preferable to having the work in that subject handled by the engineering faculty. Of course, if the size of the student body warrants it, the problem may be solved by the assignment of work for engineering students to the instructors or professors of a department best qualified by preparation and sympathetic interest for such work.

(Signed) N. M. EMERY,
Vice-President.

University of Missouri.

It is not advisable to have the instruction in mathematics, English, etc., given under the supervision of the engineering faculty. I think, however, there should be such coöpera-

tion between the teachers of mathematics, English, etc., and the dean of the faculty of the engineering school, as to make the teaching in these subjects as effective as possible for engineering students. This can be easily secured, I believe, by conferences between the teachers of the above-mentioned subjects and the dean of the school of engineering and I think in this University the teachers would be glad to have suggestions from the deans of the professional schools in regard to any modifications in methods that the deans feel ought to be made in the case of their students. My objection to putting English, mathematics, etc., under the engineering faculty is a fundamental one, since to do this would logically result in having the English work supervised by as many different deans as there are professional schools in which the subject is taught.

(Signed) J. C. JONES,
Acting President.

The Johns Hopkins University.

The cordial coöperation which exists here between the faculty of arts and sciences and the professional faculty of engineering has caused us to believe that our present plan, under which these preliminary subjects are under the immediate jurisdiction of the faculty of arts and sciences, is a better plan for us to pursue.

(Signed) FRANK J. GOODNOW,
President.

University of Illinois.

In reply to your recent inquiry concerning the advisability of having instruction in mathematics, English, etc., under the direction of the faculty of the Engineering School here, I will say that such a plan is contrary to our policy at the University of Illinois. It is our feeling that the regular instructors of those subjects are fully capable of giving satisfactory training to students of the College of Engineering.

(Signed) DAVID KINLEY,
President.

The University of Minnesota.

There is a wide difference of opinion as to whether English, mathematics, and so forth, should be taught by the engineering faculty in order to obtain better instruction in these subjects. There is less difference of opinion as to

whether some of the instruction in these subjects should be supervised by the engineering faculty. It is my personal opinion that some of the English and some of the mathematics might very properly and with distinct gain to the students be supervised by the engineering faculty. The amount would be much less than is commonly supposed.

There is involved in your question a question of principle which does not apply to engineering faculties alone. It is the question of the extent to which special phases or particular applications of subject matter shall be taught by special faculties. It is well known that we now have text books on farm mathematics, shop mathematics, engineering mathematics, home economic mathematics, and I presume we shall have others in the course of time. We also have courses in business English, English for engineers. I know of no reason, if this practice is to be encouraged, why we should not extend the tendency and provide special courses in English for dentists, pharmacists, nurses, doctors, teachers, and miners.

When such courses are established two things are assumed. The first is that students will not acquire a mastery of the terminology of their special fields through the instruction which they receive from the specialists in these fields. And the second is that the fundamentals of a subject can be taught best by means of special applications. Sometime ago I saw a review of a book on farm arithmetic. The reviewer, a scholar of distinction in the field of mathematics, stated that after a careful examination of the text he was unable to find that the mathematics in it differed in any essential from the mathematics found in all other arithmetics. The only difference he found was that it contained a number of problems dealing with farming and farm life. The reviewer, I think, was correct in his statement. His remarks may be applied to shop mathematics, engineering mathematics, or any other special application of mathematics. Indeed, they may be applied to business English, English for engineering students or any other special group of students. Special applications of fundamental priciples and concepts are both desirable and necessary, but the attempt to apply without first teaching the principles in a thoroughly clear, logical and concrete way, all of which I believe can be done, inevitably results in a waste of time and reduces to the lowest possible minimum the transfer value of the instruction. The tendency

to specialization has been accompanied by an over-exaltation of the importance of specialization, and as a result men are thinking less in terms of principles and more in terms of things—a consequence which is unfortunate from the standpoint of science and scholarly achievement. Another of the natural outcomes of this tendency has been a widening schism in ranks of those in the same or in related fields. The need of a swing back to an appreciation and understanding of both points of view is imperative. More coöperation in mapping out the programs for groups who have definite objectives in mind is sorely needed.

Cordially yours,
(Signed) L. D. COFFMAN,
President.

University of Pennsylvania.

We have always insisted that it was better for an engineering student to have mathematics, English, etc., taught by the department of instruction in those subjects. In the case of mathematics and physics it is important that the instructor have a knowledge of engineering problems, and in a number of cases the instructor is himself a trained engineer.

In the case of English there are two questions that present themselves. First, as the study of English is a means to general education and culture, it is better in this connection that English be taught to engineering students, as it is taught to other students. The second is the use of English as a vehicle for technical papers of engineering students. We have found that if we can teach a student to write English clearly, he would readily acquire in his engineering course the necessary technical vocabulary. We have made the attempt to have certain courses devoted to such subjects as the description of machinery and the drawing up of specifications in which the coöperation of both the engineering teachers and the teachers of English is necessary. In a word, at the University of Pennsylvania, the engineering students are taught English by members of the department of English who, after trial, have been found peculiarly adapted to this particular kind of work. The same is true of mathematics and physics.

(Signed) J. W. PENNIMAN,
Provost.

University of Colorado.

I think it is advisable to have engineers instructed in mathematics and English by instructors who have had engineering training and under the control of the engineering faculty. I believe that teachers of mathematics and English should be appointed to the general university departments in these subjects and assigned to teach the classes in engineering because of their peculiar fitness for this sort of work. In the selection of these teachers the dean of the Engineering School should have a weighty voice. I favor the appointment of these instructors as members of the University department of mathematics or English for the sake of general unity of these departments in the university, but I do believe that those instructors who teach engineers should be chosen because of training in engineering subjects.

(Signed) O. C. LESTER,
Acting President.

University of California.

The long-established policy of the University of California is to have instruction in various subject matters handled by an appropriate department, each of which gives the instruction along its own line for students in each of the colleges. Thus, for instance, the Department of Mathematics gives certain courses in general mathematics, which are ordinarily taken by the students in the College of Letters and Science. It gives two specialized courses, limited to students in the College of Commerce. It has other specialized courses, which are given to engineering students. The department of English, similarly, gives some special courses for Commerce students, and other courses, limited to engineering students. This is the general policy of the University, and while there are occasional slight variations from the rule, the principle here is well established, and presumably it is approved of by the Academic Senate.

According to our scheme, the colleges constitute cross-sections of the departments, the College of Civil Engineering, for instance, being composed of students and instructors who are working towards the attainment of a degree in civil engineering, the courses of instruction which are being taken by these students being scattered around among the various departments, not limited to any one college, but running throughout the University as a whole. We have ac-

cordingly a Department of Civil Engineering, just as we have a Department of Mathematics. Obviously, the relation between the Department of Civil Engineering and the College of Civil Engineering is very intimate, but, technically, the Department of Civil Engineering stands in the same relations to the various colleges, and to the other departments, as that of, say, the Department of Mathematics.

(Signed) H. R. HATFIELD,
Dean of Faculties.

University of Kentucky.

The answer depends, somewhat, on the way in which a university is organized. If it is organized on a basis of departmental instruction extending clear across all colleges, there seems to be no reason why the engineering students might not have the type and kind of instruction that they should have. That is, the department of mathematics or English might, through coöperation with the engineering faculty, secure the kind of instruction that would meet the needs of engineering students. This would, at the same time, obviate the conflict into which different departments in the same subject are likely to fall, where each college has departments of mathematics and English of its own.

(Signed) FRANK L. MCVEY,
President.

The State University of Iowa.

Instruction in mathematics, English, etc., should be given under the coöperative direction of the Liberal Arts and the Engineering faculties. This method is followed here with satisfactory results.

(Signed) W. A. JESSUP,
President.

University of Arizona.

Instead of turning engineering students over to members of the faculty in Liberal Arts for the study of cultural subjects, our organization makes any member of any of our faculties who teaches required work toward any degree a member of the faculty of that college in which the student secures his degree; or in other words, if students of engineering are required to take certain courses in English, some member of the faculty of the English Department becomes a member of the faculty of the College of Mines and Engi-

neering with full voice in organization of the courses of that college.

It has seemed to us that the advantage of this arrangement grows out of the fact that the instructor secures by this means the viewpoint of the college towards whose work he is contributing certain courses.

(Signed) C. B. VON KLEIN SCHMID,
President.

Cornell University.

I do not think it of great importance that the teachers in mathematics, English, etc., should be members of the engineering staff. I am inclined to think that it might be a real detriment to student and faculty if such be the case. A professor of English, for instance, who has nothing to do but teach engineering students, and who may be cut off from association with other teachers of English, must, in my opinion, soon degenerate to a mere instructor in fundamental English. Much of the incentive that comes to teachers comes through association with their fellows. There is an incentive in being one of a group devoted to the teaching of a certain subject. I am inclined to think also that better instruction is given in the large departments, when properly organized, than it would be where the instructors are taken away from their fellows, and set off in a corner of the engineering college. I cannot believe, for instance, that we could possibly give as good a course in chemistry as is now given for us by the Department of Chemistry.

The whole solution I believe lies along another line. The courses in English, mathematics, etc., for engineers should not be the same as those for the rank and file of men in arts and sciences, and my experience has been that where such courses are given specifically for the engineering students the problem was solved partially at least. That is the method we are pursuing here in mathematics, economics, physics, etc. Special courses are organized for engineering students. I believe this is the important phase of the matter and not whether the instructor does or does not belong to some particular group.

(Signed) DEXTER S. KIMBALL,
Dean, College of Engineering.

University of Arkansas.

I know of the old conflict between the mathematics department and the engineering department as to what should

be included in mathematics for engineers, and I can see some reason for a division of opinion there. Nevertheless, I believe that the proper place for mathematics for engineers is in the department of mathematics. Coöperation should largely eliminate the difficulty.

I can see no possible reason why the instruction in English for engineers should be taken out of the department of English. Engineers must write and speak and read the same kind of English other people read. The trouble, I think, with many engineering courses is that they do not allow students enough time for instruction in English and other subjects outside of technical teaching.

(Signed) J. C. FUTRALL,
President.

Northwestern University.

We have tried out the plan of having mathematics and English for the engineering students given in the regular section of the College of Liberal Arts. We have made some experiment in having such work given in the Engineering School, and we have considered the forming of sections for engineering students in the regular departments of the College of Liberal Arts. Personally, I have insufficient data to come to a conclusion as to which of the three is the best plan.

It seems to me that it would be desirable to have the instructors hold memberships in the Engineering Societies, attend meetings and take a constructive part in the programs.

(Signed) WALTER D. SCOTT,
President.

University of Michigan.

As matters now stand in this and most universities, where the Engineering College is not a graduate school and does not demand even a year or two years previous work in the Literary College, I think that there is a better reason to have these non-technical subjects, especially English and foreign languages, taught by members of the staff of the Engineering College. The problems are so different and the students themselves are of such a different character from what is found in an Arts College as to make this course, under present circumstances, almost imperative. It is necessary, for one thing, that the members of the staff in these courses should share fully in the esprit de corps of the En-

gineering College, entering with all possible vigor into the prosecution of its aims and ideals and contributing heartily and loyally to the solving of its peculiar problems. This it is difficult for an Arts College teacher to do.

The students, moreover, deserve sympathetic consideration. In a mixed class of arts students and engineers, the engineer cannot but feel himself out of place; furthermore, working with his own fellow, he is more apt to perceive the real value to him of the subject matter of these non-technical courses. It is not always easy to convince an engineer that it is worth his while to study languages, for instance, but if you have him by himself the chances are better that he will see that here there is something that will not only serve to develop him as a man, but also tend to enhance his standing in professional life.

In our College of Engineering and Architecture the development of courses in English, modern languages, and mathematics under members of their own staff has been most successful, and I believe that their success is a great argument to be applied in this controversy, if it is a controversy. The courses which they have arranged for the special needs of Engineering students have been so well appreciated by the students themselves that at the present time the optional elections in English, to take one example, far exceed those in the required courses. It is quite a triumph, I feel, to make such subjects succeed in an Engineering College, with its necessarily all too materialistic environment. I do not think, furthermore, that the teachers in these courses have in any sense lost caste. On the contrary, their colleagues realize that they are doing a difficult job well.

What I have said applies to present conditions. We must perhaps look forward to a time when engineering will be either a graduate course, or one to be entered upon only after one or two years in the Arts College. I cannot but feel that this would in the long run be to the benefit of the engineering profession generally. If this comes, the policy with regard to non-technical courses which I now feel to be wise would doubtless have to be altered.

(Signed) M. L. BURTON.
President.

The University of Nebraska.

At the University of Nebraska there are ten colleges, all of which require college English. The Arts College does this gen-

eral work for the nine other colleges. We could not have a distinct separate type of English for each of these without meeting great difficulties in administration and greatly increased expense.

There could be a certain differentiation in the instruction in the different sections so that the engineers and the pharmacists would not take precisely the same course, but I think it undesirable to inaugurate any movement that might lead to the establishment of a department of Engineering English, of Pharmaceutical English, of Agricultural English, of Business Administration English, of Medical English, Legal English, Pedagogical English, and the like.

(Signed) S. AVERY,
Chancellor.

Stanford University.

While it is important that those giving instruction in English and mathematics to engineering students should be in sympathy with the aims and needs of these students, I consider it a mistake to have them under the supervision of the Engineering Faculty. Engineers require the highest sort of broad training to take their proper place in modern civilization. They need to view fundamental subjects from the independent standpoint of those devoted to these subjects. The present departmental organization of universities needs to undergo a lot of hard knocks. It is too rigid, too pedantic and too full of personal equations.

(Signed) ROY LYMAN WILBUR,
President.

BRANCHES.

LIST OF BRANCHES REPORTED FEBRUARY 25, 1922.

Case School of Applied Science, Chas. S. Howe.
Cincinnati, University of, Herman Schneider, Chairman.
Colorado, University of, Ivan C. Crawford, Chairman.
Georgia Tech Section, R. S. King, Chairman.
Kansas-Nebraska Section, G. R. Chatburn, Chairman, R. A. Seaton, Secretary.
Marquette University, J. C. Pinney.
Michigan, University of, J. Raleigh Nelson.
Minnesota, University of, W. E. Brooke.
New England Section, G. C. Anthony, Chairman, H. S. Boardman, Secretary.
New Hampshire College, Calvin H. Crouch.
New York University, C. T. Schwartze, Chairman.
Ohio State University, The, Wm. T. Magruder.
Pennsylvania College, Frank H. Clutz.
Pittsburgh Section, P. M. Dysart, Chairman, C. B. Stanton, Secretary.
Purdue University, C. F. Harding.
Rensselaer Polytechnic Institute, John G. Fairman, Secretary.
St. John's University (China), John A. Ely.
Stevens Institute of Technology, L. A. Hazeltine, Chairman, F. C. Stockwell, Secretary.
Swarthmore College, L. Fussell, Chairman, C. G. Thacher, Secretary.
Syracuse University, Louis Mitchell.
Texas, A. & M. College of, J. C. Nagle, Chairman.
Tufts College, C. H. Chase, Chairman, E. B. Rollins, Secretary.
Vermont, University of, J. W. Votey.
Yale University, P. G. Laurson, Chairman, W. J. Wohlenberg, Secretary.

UNIVERSITY OF MINNESOTA.

"I beg to state that your membership committee recently called a meeting. The attendance numbered about 30, and it was the sense of the meeting that we establish a Minnesota Section of the Society. A committee was appointed to submit plans and draft a constitution.

"Meanwhile, I am sending you 11 applications for membership and hope to send a dozen more within a week or so.

"If the interest shown in our first meeting is continued in the next, I hope to be able to make an application for a Minnesota Section of the Society."

(Signed) W. E. BROOKE.

February 20, 1922.

PURDUE UNIVERSITY.

"Professor C. F. Harding will no doubt write you about the S. P. E. E. meeting which we had at Purdue University on Thursday, February 16th. Eighty people attended this meeting and eight or ten more had to be turned away on account of lack of room. The subject discussed at the meeting was 'Sectioning students in accordance with their ability to progress.' The meeting started at 6:00 and did not end until about 10:00. Professor Harding told me that he would send you a complete statement concerning this meeting."

(Signed) A. A. POTTER.

BRANCHES AND SECTIONS.

The Ohio Section.

To the Ohio Members of The Society for the Promotion of Engineering Education.

Gentlemen: At the suggestion of Past-President Charles S. Howe, I am issuing this call for a meeting of the Ohio members of the S. P. E. E. for Saturday, April 15, at Ohio State University, to discuss teaching problems, as suggested by President C. F. Scott, and other pertinent topics. The Association of Ohio Colleges and other Ohio educational societies will be in session here at that time. Sessions may be held from 9:00 A.M. until noon and from 1:30 until adjournment.

I solicit suggestions as to the subjects to be discussed and the names of persons who might be willing either to prepare and read a paper or to lead in the proposed discussions. Your prompt attention and reply are requested with the object of making the meeting as worth while as possible.

Very truly,

Wm. T. Magruder,
Past. Pres. S. P. E. E.

Yale Branch.

How Physics is Taught.

The January meeting of the Yale Branch, Society for the Promotion of Engineering Education, was a presentation by the Physics Department of the way physics is taught. A straightforward specific presentation of the content of the courses, the aims and objectives in view and the methods pursued was followed by a trip through the laboratory and explanations of the laboratory work done by the students. The presentation was followed by questions by the teachers

from the various departments and a general discussion.

The following list of experiments is given engineering students in the course in physics.

Sophomore Year: General Course of Laboratory Experiments in Physics.—(1) Linear Measurements with a Scale and Vernier; (2) Determination of the Density of a Solid; (3) Equilibrium of Concurrent Forces; (4) Equilibrium of Parallel Forces; (5) Simple Pendulum; (6) Simple Machines; (7) Angular Acceleration; (8) Surface Tension; Determination of the Mean Pitch of the Screw of a Micrometer Microscope; (9) Boyle's Law; (10) Hooke's Law; (11) Application of Archimedes' Principle to the Determination of Specific Gravity and to Floating Bodies; (12) Frequency of a Stretched String; (13) Velocity of Sound by Kundt's Tube Method; (14) Velocity of Sound in Air by the Resonance Tube Method; (15) Thermometer Testing; (16) Coefficient of Linear Expansion; (17) Specific Heat of a Solid; (18) Latent Heat of Fusion; (19) Mapping Magnetic Fields; (20) Electrostatics; (21) Preliminary Experiments on Current Electricity; (22) Electrolysis; (23) Ohm's Law; (24) Resistance by means of a Wheatstone Slide-Wire Bridge; (25) To Arrange a Galvanometer as a Voltmeter; (26) To Arrange a Galvanometer as an Ammeter; (27) Electromotive Force by the Potentiometer Method; (28) Electromagnetic Induction; (29) The Determination of the Mechanical Equivalent of Heat by an Electrical Method and the Efficiency of an Electric Heater; (30) Reflection at Plane and Cylindrical Surfaces; (31) Snell's Law; (32) Index of Refraction by Total Reflection Astigmatism; (33) Focal Length of a Convex Lens; (34) The Determination of the Wave-Length of Light by Means of a Diffraction Grating.

Sophomore Year and Junior Year: Engineering Science Course of Laboratory Experiments in Physics.—Linear Measurements with a Scale and Vernier; Determination of the Density of a Solid; Angular Acceleration; Equilibrium

of Concurrent Forces; Determination of the Acceleration due to Gravity; Equilibrium of Forces in a Hoisting Crane; Simple Machines; Relation of Torque, Angular Motion, and Moment of Inertia; Determination of the Mean Pitch of a Micrometer Microscope—Young's Modulus; Determination of the Density of Solids and Liquids by Aid of the Principle of Archimedes; Boyle's Law; Thermometer Testing; Coefficient of Linear Expansion; Specific Heat of a Solid; Latent Heat of Fusion; Latent Heat of Vaporization; Mechanical Equivalent of Heat; Vapor Pressure of Water at Different Temperatures; Electrostatics; Law of Magnetic Attraction; Verification of Ohm's Law; Resistance and Electromotive Force by Ohm's Method; Resistance by Means of a Wheatstone Slide-Wire Bridge; Measurement of Resistance by means of a Box Bridge; Specific Resistance and Temperature Coefficient of Resistance; Electrolysis; To Arrange a Galvanometer as a Voltmeter; To Arrange a Galvanometer as an Ammeter; The Determination of the Mechanical Equivalent of Heat by an Electrical Method and the Efficiency of an Electric Heater; Electromotive Force by the Potentiometer Method; Thermo-Electromotive Force; Comparison of Capacities of Condensers and of Electromotive Forces by the aid of a Ballistic Galvanometer; Inclination of the Earth's Magnetic Field by the Earth Inductor Method; Distribution of Magnetism in a Bar Magnet; Mutual Induction; Magnetic Hysteresis in Iron; Frequency of a Tuning Fork by the Graphical Method—Frequency of a Stretched String; Velocity of Sound in Air by the Resonance Tube Method—Velocity of Sound by Kundt's Tube Method; Candle Power of a Lamp; Measurement of the Angle of a Prism and its Index of Refraction; Focal Length of a Convex Lens; Magnifying Power of a Convex Lens; Magnifying Power of a Telescope and of a Microscope; Determination of the Wave-Length of Light by Means of a Diffraction Grating.

The apparatus was developed on the basis of 8 duplicate

sets for each experiment. The visiting engineers remarked upon the fact that each experiment involved a minimum amount of apparatus and manipulation with a maximum amount of thinking. No experiment was found to be so complicated as to require more than a glance at the equipment and a sentence of explanation to give an adequate idea of its object and the process of experimentation. In this laboratory, for the first time, the student encounters the demand for rigid quantitative measurements and logical analytical thinking.

The present course, as explained by Dr. Zeleny, is the course determined upon by a conference of Yale engineers and physicists. It is a course of 17 hours, total time of the student, during the Sophomore year on the subject of Mechanics, Electricity and Magnetism and 9 1/2 hours, in the first term of the Junior year, on Sound and Light.

Lecture room demonstrations are developed each week. A new and valuable addition has been found in a two-hour supervised computation period. This offers opportunity for developing attack, for directing the efforts of the student along proper lines and for intimate personal contact between the teacher and the student. This latter element is accented to the degree that the professor and not the instructor conducts the computation period.

The meeting proved highly enlightening. It was discovered for instance that changes had been brought about both as to method of teaching and material covered which were new to many of those present. Ideas and thoughts based on the old order of things had to be rearranged to be in accord with the new and better conditions.

Queer as it may seem to the university teacher some time was actually devoted to an exposition of the findings of the Physics Department concerning the peculiar behavior of the student when exposed to pedagogical fire. Some of the bad habits of thought were found to be, at least in part, directly traceable to processes of education, or better perhaps mis-

education, which the student was required to undergo at an earlier stage in his educational career.

In the discussion it was discovered among other things that a little unnecessary duplication of effort existed between departments.

Is it not now our most important problem to discover how this educational machinery, of which each of us is but a small part, can be utilized for the best development of the student? Some have assumed that a knowledge of the subject to be taught and isolated efforts are the best solution. Is this true or can we arrive at a better solution only by concerted effort and study of all the conditions involved?

The latter is certainly the method of research. Is our problem any less than a research involving many conditions and variables? Can we offhand without further study make assumptions and ignore conditions, or should we study conditions and arrive at the solution on this basis? If so, shall we make the study only by method of hypothetical discussions at annual meetings, or shall we in addition to this carry on a more careful survey of the conditions at home? The first step in an engineering investigation is to find the facts; a visit to the physics department is a pretty good way to find out how physics is taught. What better work can this society do?

Signed,

W. J. Wohlenberg,
Assistant Professor of Mechanical Engineering,
Secretary, Yale Branch, S. P. E. E.

New England Section.

It is planned to hold the third meeting of the New England Section at Brown University, Providence, R. I., the middle of March. Information can be obtained from H. S. Boardman, Secretary, University of Maine, Orono, Me.

LETTERS FROM INSTITUTIONS WHERE BRANCHES HAVE NOT BEEN FORMED.

Note: The Editor was impressed with the following letters from institutions which had not formed branches earlier in the academic year. It would seem that President Scott's suggestion of topics in the September number of ENGINEERING EDUCATION and the formation of branches had at least encouraged, if not developed, a healthy discussion of educational problems in engineering faculties. (See page 282.)

The **College of Applied Science, State University of Iowa,** has had no branch or sectional meeting of the Society for the Promotion of Engineering Education during the current year, but the entire faculty of the college has met to consider the general subject of the improvement of the college course and has decided to hold a series of meetings to consider this question, including the general subject of teaching, and has provided for a committee to report at the first of these meetings on the general topic, "What is the matter with our product!"

This question will be considered broadly and requests for information will be made of those who have employed our graduates. It seemed to us wise to begin in this way to try to discover from the outside what our points of weakness are. We shall then discuss the possibilities of improvement. We shall probably have not more than one or two meetings a year, but this will depend on the nature of the report of this first committee.

W. G. RAYMOND.

Pennsylvania College.—We have had no such meetings and so can give no minutes. I hope to get the teachers together next month when the examination work is cleaned up.

F. H. CLUTZ.

Purdue University.—As yet, a Branch Organization has not been completed at Purdue University for the reason that practically all of the members of the organization meet quite regularly under the auspices of the Sigma Xi, the American Association of University Professors, and the informal staff meetings of the engineering schools. In all of these meetings, problems are discussed which ordinarily form a part of S. P. E. E. programs. However, we are planning to get this particular group of members together for a dinner meeting

in the near future and to determine the advisability of an additional organization.

Sectionalization of Students.—One of the important problems under consideration is that of sectionalizing engineering students on a basis of ability to carry advanced work, rather than by the arbitrary method ordinarily adopted in the Registrar's office.

It is generally recognized that in technical schools administering work to large classes, the curriculum and daily administration of the work have to be adjusted to the average student, while the more able fellow and the one who is slower to grasp new ideas are being taught at a disadvantage. It is highly desirable, therefore, if the details can be satisfactorily worked out, to have, even in the single course, different classes of work covered by the slow, average and exceptionally brilliant student. The writer, in a paper before the S. P. E. E. a number of years ago, recommended the adoption of such a plan, but the difficulties in administration under our present system at Purdue University have caused us to delay its adoption.

It has been felt that the granting of honors or prizes would not meet the requirements for the more able men, but that in institutions where a certain number of credits were required for a degree, the granting of more credits to advanced sections in a single course, and fewer credits to the backward sections might meet the requirements satisfactorily. This is being done in some institutions. We hope to place our requirements for graduation upon such a basis in the near future.

In the meantime, it is quite probable in some courses a voluntary plan of sectionalizing may be adopted, giving the students a choice of sections, with the understanding that in one group of sections only will it be possible to secure the highest grades. In these sections an additional amount of ground will be covered in a given course. A transfer from one section to another will be made possible, if the details can be worked out, during the first half of the semester. It has been felt that if additional work is required in some sections with no additional credit toward graduation, that the sectionalization must necessarily be voluntary upon the part of the student.

Freshmen Problems.—As is the case of many other institutions, we have been administering engineering problem work to freshmen in the engineering schools. Although we do not feel that the present course is entirely satisfactory, it must

be looked upon as a kind of an experiment. The problems used during the first semester, involving four from each of the engineering schools, bear the following subjects:

Civil Engineering.

1. Study of Topographic Maps.
2. The Study of Drainage Area.
3. Study of Power Plant.
4. Study of Brown Street Bridge—Details and Cost.

Mechanical Engineering.

1. Inspection of Purdue Power—Fuel.
2. Inspection of Purdue Power Plant—Stokers, Boilers, Stack.
3. Inspection of Purdue Power Plant—Engines and Pumps, Heating and Ventilating.
4. Motor Transportation West Side to City.

Electrical Engineering.

1. Inspection of Purdue Power Plant—Electrical Equipment.
2. Electrical Distribution System.
3. Study of Direct Current Motors and Generators.
4. Study of Electrical Circuits.

These problems include from 15 to 50 questions each, which are answered in most cases after inspection of the particular apparatus involved in the problem.

The purpose of the course is to acquaint the Freshmen with the types of problems likely to be met in the various branches of the Engineering profession, and to acquaint them with the more important equipment involved and more intimate association with the experienced members of the various teaching staffs.

Although the results of such problems cannot be determined for some time, it has been felt that this contact with the Freshmen is well worth while, and that improvements in the course will be largely confined to changes in details of administration, rather than in general policy.

Agricultural and Mechanical College of Texas.—Notwithstanding the question has been suggested several times in the past we have not yet organized a local section here at College. This morning, however, at our meeting of the Engineering Teachers Conference of the A. & M. College of Texas, the

matter was again brought up by Professor F. C. Bolton, and I appointed a committee of five to consider the question during the next month and to report at our February meeting. Both Professor Bolton and I believe that it would be desirable to merge our Conference into a S. P. E. E. Section but as there are a number of our teachers who attend the Engineering Teachers Conference who may not desire to become members of the parent society, because of the dues, we have not pushed this matter heretofore. Mr. Bolton informs me, however, that President Scott has told him that they would not be barred from taking part in our meetings even though they are not members of the parent society.

We have about 70 or 75 teachers here who are members of our Conference and I am satisfied that the organization of a Section here would increase the membership in the parent society.

C. F. HARDING.

The **Engineering Faculty of the University of Utah** meets monthly to consider problems of engineering education. The problem of how to train the student in the effective use of English has occupied most attention during recent months. As a result a course in the "Writing of Technical Reports" began with the winter quarter. This course is prescribed for all senior engineering students. The course promises to be the most valuable one required of our seniors. It is in charge of Professor Robert S. Lewis, of the Department of Mining and Milling.

J. F. MERRILL.

COMMENT BY THE PRESIDENT.

Branch activity is not a formal matter in accordance with by-laws—there are none. It is a movement, a principle, an extension and specific practical application of the fundamental aims of this Society. The idea which initiated the Society itself was annual national meetings where engineering teachers could discuss their common problems. Branches enable members everywhere to meet frequently for the same purpose.

The benefit which this Society has been to engineering education has come through extending the ideas of a few to the many. Some institutions say they need no branches because they are already having meetings for educational dis-

cussion. Such meetings are excellent, but do not assist other institutions or other teachers of engineering. The benefit will come by extending suggestions to others and being a part of the new educational movement.

Interchange of ideas and suggestions is an important object of branches. I know that the Yale group has benefitted from its meetings in ways they did not anticipate, and I will be surprised if the reports of our meetings are not appreciated by others.

Hence, I urge that the S. P. E. E. members at those institutions where educational discussions are already conducted, appoint a chairman and a secretary, co-operating and aiding the movement and reporting the activities to the Secretary of the Society.

February 25, 1922.

S. P. E. E. MEETING AT TORONTO.

BY C. R. YOUNG,

University of Toronto.

In connection with the annual meeting of the American Association for the Advancement of Science, the Society for the Promotion of Engineering Education held a meeting of two sessions in Toronto, on December 30, 1921. About one hundred persons, for the most part especially interested in engineering or technical education, attended these sessions and the discussion was of a vigorous and helpful character. President Chas. S. Howe, of the Case School of Applied Science, Cleveland, occupied the chair at both sessions, and through his wide knowledge of educational problems, his tact and courtesy, the sessions were highly successful.

At the morning session, on December 30, the general topic was "The Relation of Industry and the Practicing Engineer to Engineering Education." An address was given by R. C. Harris, Commissioner of Works, Toronto, followed by an animated discussion.

Mr. Harris stated, in opening, that as a result of his somewhat extensive experience with engineers, he had come to the conclusion that they were in general deficient in business training. The engineer is frequently unable to relate the creation of physical things to the value of the dollar. He should make the highest type of administrator, but because of insufficient instruction, or some other reason, he is disposed to confine his attention too much to the physical aspects of his work. On the contrary, he should regard himself as a trustee for the physical and financial welfare of his fellows. The engineer does not study human problems sufficiently, said Mr. Harris. Not often is he able to predict with certainty what given people will do under a given set of circumstances. He regards himself too much as a builder and not enough as a solver of economic and human problems.

Certain desirable characteristics of engineers were outlined by Mr. Harris. The engineer should have courage. Engineering failures sometimes occurred, he said, through the engineer giving the client what he wanted rather than what he knew to be necessary. He should have initiative; he should be positive rather then neutral; should have foresight; be willing to delegate authority; able to assume large responsibilities under emergency conditions; be public spirited, and a social factor in his community.

Mr. Harris suggested that the training of engineering instructors might be greatly furthered by the provision of opportunities for travel and contact with the leaders of the profession in other parts of the world.

General Mitchell, dean of the Faculty of Applied Science and Engineering of the University of Toronto, in commenting on Mr. Harris's address, stated that members of the staff of the University of Toronto were encouraged to cultivate outside interests.

Industrial Viewpoint.

S. B. Chadsey, of the Massey-Harris Co., supported the view of Mr. Harris that the average technical graduate was inadequately equipped to deal with the varied economic and social conditions with which he is likely to be confronted. He regarded the graduates as remiss in that they seldom stated frankly to the engineering college the essentials for the success of graduates in the pursuit of their profession.

G. W. Winckler, Toronto, advocated the granting of sabbatical years to engineering instructors to improve their knowledge and give fresh contacts and enthusiasm.

Prof. R. W. Angus, of the University of Toronto, expressed doubt of the practicability of teaching very young men in college such things as ruggedness of character and ability to act with wisdom in an emergency. He advocated the more extensive contact of a teaching staff with the outside business world.

Prof. Ernest Brown, of McGill University, stated that Mc-

Gill had introduced instruction in economics some years ago with satisfactory results. Engineering courses in Canada should be, said Prof. Brown, primarily technologic. This type of equipment was of immediate value on graduation, but as time went on, the engineer's work became more and more of a business character, being in the case of some consulting engineers only 20 per cent. technologic. The speaker believed that engineering college training should be of such general and basic character as to fit men for many kinds of work. The exact subjects of study do not much matter, Prof. Brown said, if the student is able to sharpen his mental tools thereby.

H. W. Bibber, Massachusetts Institute of Technology, advocated the more careful selection of students on entrance to engineering colleges. The social qualities, he thought, were best brought out in college by college activities.

President Howe stated that at the Case School of Applied Science, the men who employ engineers were called in and questioned concerning the character of the product desired.

Engineering Education for the Industries.

At the opening of the afternoon session on Friday, a paper by Prof. Charles F. Scott, President of the Society for the Promotion of Engineering Education, on "Professional Engineering Education for the Industries," was read by Prof. C. R. Young.

Julius M. Williams, member of the Board of Education, Hamilton, in commenting on the paper, pointed out that the owners of business were frequently uneducated men and that there was a certain prejudice against the claims of the educated man for preferment in industry.

President Howe expressed the fear lest the present trend toward the adoption of courses in business administration might be overdone. Courses in business had been introduced at Case School, he said, to give the student some conception of the nature of the business situations he would have to deal

with, rather than to impart much detailed instruction. Such was desirable, he thought, since a large proportion of engineering graduates became executives after they had been out 15 or 20 years.

Prof. Peter Gillespie, University of Toronto, questioned the wisdom of the engineering colleges taking the time to instruct a student how to dictate a letter. He thought that the time must be spent to better advantage in giving instruction in subjects that required real mental effort.

Engineering Education vs. Vocational Training.

On the conclusion of the discussion of the previous paper, Dr. F. W. Merchant, Director of Industrial and Technical Education, Province of Ontario, addressed the meeting on the field of the technical schools of Ontario and their relation to the work of the engineering colleges.

After clearly describing the nature of the work carried on in the technical schools, Dr. Merchant assured his hearers that there was no overlapping whatever between the technical schools of Ontario and the engineering faculties of the universities. There is no counterpart in Ontario to the polytechnic and technical institutes of the old world and of the United States. The legislation governing technical education in the province, Dr. Merchant asserted, provides that the technical schools shall not undertake engineering courses of the type offered in the universities.

The product of the technical schools would be concerned, said the speaker, with operation and maintenance rather than with design on construction. He thought that such schools formed an admirable selective agency for the engineering colleges, and that the courses offered provided a good training for entrance to the universities. As an instance of the excellent performance of technical school graduates in engineering courses, Dr. Merchant cited the case of the thirty men from the Central Technical School in Toronto who entered upon engineering courses in the University of Toronto in the autumn

of 1920. Of these, none failed and the average standing attained was very high. He advocated the recognition of the practical work in technical schools for university entrance, as equivalent to one foreign language, on the same basis as practical work in commercial schools is recognized for admission work in university commerce courses.

President Howe stated that while the general opinion in the United States appeared to be favorable to the strictly academic qualification for entrance to engineering colleges, the candidates from the technical schools often did very well.

Gaps in Industrial Education.

In a paper by Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, which was read by Prof. C. R. Young following the discussion on Dr. Merchant's address, it was pointed out that in the United States there was a gap in industrial education between the elementary trades schools and the professional engineering schools of university grade. "It is imperative," said Prof. Jackson, "to give to thousands of young men who are to make the bulk of the corporals and sergeants of industry that character of training which makes for self-support in the industries." There must, however, be a clear distinction between trades and education and the theoretical and advanced education of men planning to join the engineering profession. The grade of the trades school cannot be exalted without losing its clientele, while the schools for training young men for becoming professional engineers should be of university rank. Continuing, Prof. Jackson expressed the view that "powers of exact mental analysis of problems when the facts are exactly related and beyond that the powers of accurate synthesis are essential to creative industrial practice, and education that does not provide for sound, deep and broad study of scientific theory is inadequate for the industrial engineers who are to become creative leaders."

President Howe, in discussing the paper, outlined the effect of entrance conditions on the performance of students in engi-

neering colleges in the United States. At Case School, he said, less than 50 per cent. of those who registered actually graduated, more men leaving at the end of the first year than at any other time.

Prof. E. Brown, of McGill University, stated that in McGill a considerable number of unsuitable students had to be cleared out of the first year at Christmas.

Dean George B. Pegram, of Columbia University School of Engineering, described the nature of the selection of students at Columbia, pointing out that with a six-year course most of the elimination was likely to be done before men reached the strictly engineering part of the courses.

In the dinner of the Engineering section held on Friday evening, the Society for the Promotion of Engineering Education took part along with a number of other engineering and professional societies.

Arrangements for the meetings of the S. P. E. E. were made and carried out by a committee consisting of Professor C. R. Young, Chairman, Professors G. R. Anderson, M. C. Boswell, A. T. Laing, and T. R. Rosebrugh of the Faculty of Applied Science and Engineering, University of Toronto. The society is much indebted to the kind coöperation of Mr. J. B. Tyrrell, Vice-President of the Engineering Section A. A. A. S., Professor R. W. Angus and Professor Peter Gillespie of the local committee of the A. A. A. S. for the facilities offered for the carrying on of this successful meeting.

PURPOSES AND METHODS OF QUIZZES AND EXAMINATIONS.

BY IRA O. BAKER,

Professor of Civil Engineering.

A SYMPOSIUM BEFORE FACULTY OF COLLEGE OF ENGINEERING, UNIVERSITY OF ILLINOIS, JAN. 9, 1922.

The following comments refer to informational or textbook subjects, such as Masonry Construction and Engineering Contracts.

1. Quizzes and examinations are important educationally: (*a*) because they help the student to get a new view of the subject (not merely a review); (*b*) because they give the student training in rapidly acquiring a summary of the subject; (*c*) because they help the student to get an estimate of his own ability; and (*d*) because they teach the student to work under stress, and help him to gain self-control. I seldom, almost never, give surprise quizzes—partly to emphasize the first reason above. To emphasize the third reason, I always indicate the errors, grade each answer, and return the answers to the student; and usually I require those that do not pass to re-write the examination—sometimes with the textbook open while writing, but not permitting the use of the phraseology of the book; and sometimes with the textbook closed.

2. It is very important that the question shall show clearly and unequivocally just what is expected in the answer; but of course the questions should in no sense or to any degree put words into the student's mouth.

3. The examination should not be too long; that is, should not tax the student's rapidity or physical endurance in writing. The sole purpose is to test his intellectual ability. An unduly long quiz or examination tends to cultivate slovenly English, careless penmanship, and confused mechanical form;

and therefore tends to discredit good teaching along these lines.

4. It is important that the list of questions should consist of, say, about one third each of the three following types: (*a*) Questions simply calling for facts, appropriately called memory questions. These test only the memory of the student. (*b*) Questions involving the organization of the subject, appropriately called topical questions. They test the ability of the student to discriminate the relative importance of different parts of the subject, and train him in presenting his thoughts clearly and in a logical order. (*c*) Questions involving the application of the principles studied, which may be called practical questions or aptitude-test questions. Apparently much college teaching, particularly that in colleges of engineering, is of relatively small value, because it gives too little attention in recitations, quizzes, and examinations to questions of types (*b*) and (*c*); and in all probability a considerable part of such instruction does absolute harm to students, particularly poor ones, by the usual omission of questions of these two types.

The preceding statements are so strong as to require defense. Students often answer memory questions fairly well, but utterly fail in questions of types (*b*) and (*c*). Of course, the cultivation of memory has value; but memory work can never give an education of any great value. It is not what a student knows that counts; but only what he can do that is worth while.

The following instance of recent occurrence in one of my own classes illustrates the damage that is done to a student by permitting him to rely solely upon memory. In self-justification I ought to state that the student had never before been in any of my classes. In a quiz the student was asked to state "the usual percentage of voids in ordinary building sand." He replied: "400 per cent." I called him into my office, and asked what he meant by such an answer. He insisted that that was what I told the class. I tried to

get him to see that the answer was ridiculous; but he insisted that I had so taught the class. Finally I was compelled to seek what he claimed I had told the class. After a good deal of inquiry, I discovered that he was referring to a statement of mine in which I called attention to the fact that in a particular table the strength of mortar made from one sand was 400 per cent. of that made of another sand. He replied with a confident smile: "I knew that 400 per cent. related to sand." Of course any student is liable at times to make a "bull"; but such examples are by no means rare, and they are sometimes equally extreme.

Not infrequently as I have talked with students about their quizzes or examinations, I hear the remark: "If you would only ask questions, I could do better; for I never can write essays." In other words, students who have not been trained in judgment and discrimination, and in organizing their thoughts, can not do well with topical questions; but these characteristics are important factors in any education.

Again, many students will do reasonably well in both memory questions and topical discussions; and still have no adequate conception of the meaning or importance of the facts stated, nor of the relation of these facts to practical work or everyday affairs. The following example is from one of my own classes within a week. The class had been studying the manufacture of brick; and in the written quiz I asked how terra cotta could be burned so that the fire would not discolor it, nor unequal heating warp it, nor the stacking of the pieces one on the other in the kiln cause "kiln marks." One student replied: "By placing thin boards between the pieces in the kiln." Of course, he tried to answer only one item of three; and when I questioned him about his answer, he saw no incongruity. Similar examples are so frequent as to lead me to believe that much teaching is defective in this respect.

To a considerable extent the matters referred to above are evidence of wrong methods of teaching.

5. The weight to be given to each question should be clearly indicated, either by stating that the questions are of equal weight or by giving the per cent. for each.

6. It is usually desirable to give each student a well-typed copy of the questions. Questions written on the blackboard are sometimes illegible and invisible. Type-written questions should be returned in the examination book. Professional coaches and "frat" houses have been known to keep collections of examination questions, and students have been known to cram for examination by studying examination questions instead of the text-book.

7. Students should be told that they may answer the questions in any order they prefer. There are several somewhat obvious reasons for this.

8. For many years I have given to each student at the beginning of the first quiz or examination a typed sheet containing some of the above information, and also making some other suggestions about the examination. These sheets are returned with the answers, and can be used over and over; and hence the expense is unimportant.

THE COURSE SCHEDULES IN A PROFESSIONAL CURRICULUM.

BY L. L. THURSTONE,

Carnegie Institute of Technology.

In a professional school there is always a distinction between the regular students who pursue the required courses in their specified order, and the irregular students who pursue these courses more or less out of line from the specified curriculum. This distinction seems to be universal especially in those schools in which the curriculum is definitely stipulated as to subjects and sequence. It causes more or less confusion in the administrative details of a professional school to have students classified as irregular. It seems almost impossible to avoid this circumstance. A student may fall behind his regular course on account of sickness or the failure to pass certain of the stipulated courses at the stipulated time. Even if a student starts as a regular student there is no guarantee that he will remain a regular student throughout the four years of the professional course. I should like to present some suggestions which may have some value in eliminating the difficulties with the record keeping and classification of irregular students. These suggestions have much in common with the quarter system although the plan should be equally applicable to the semester system.

As I picture this plan in operation the student would register every semester not according to a schedule which is set for him but by a schedule entirely of his own choosing. The only limitation should be that he might not register for a course without having the listed prerequisites for it. The requirements for the degree should not be specified as a rigid four-year lay-out but rather as a list of minimum credits in each of several specified fields. The student would be called upon to exercise his own mature judgment, with the help of

advisers when necessary, in selecting the courses that he desires to take each semester. He would work with two conditions in mind, namely, (1) the listed prerequisites for the courses that he desires to take, and (2) the list of minimum credits in each field required for the degree.

A student would be classified as a junior, for example, as soon as he has acquired a stated number of credits. The men in the junior class would not have completed the same courses, but they would all have acquired the number of credits listed as a normal attainment for two years of college work. The classification of a man as a senior would depend simply on the total number of credits that he has accumulated and not necessarily on the fact that he has completed any specified courses.

The only difference between a regular and an irregular student would then be that the irregular student is not choosing his courses so as to qualify in the several fields required for a degree, but this distinction need not concern the administrative record keepers. A student may be deviating from the usual courses selected by most of the students either because he ignores the degree requirements or because of failures which reduce his total number of credits.

By this plan the courses would not be designated as freshman courses, sophomore courses, and so on. They would simply be listed as courses which may be elected by any student of the college whenever he chooses, provided that he can offer the prerequisites. It would of course be possible to list the prerequisites in a college in such a manner that a student could not possibly pursue anything but the rigid curriculum. The spirit of the plan should be to introduce as much flexibility as may be reasonably possible in the professional preparation of the student. The fundamental idea of this plan would be to throw the responsibility on the student in his professional course.

Another closely related problem is the number of units or credits for each course. As I imagine this plan in its ideal

form, all courses in a college would be either three hours per week or six hours per week. A three-hour course would be the basic unit. It could be called "one course" or one point or one major. A double course would meet six hours per week. The recitation courses could be listed uniformly on Monday, Wednesday, Friday at the same hour, or on Tuesday, Thursday, Saturday at the same hour. The content of the four-year curriculum would be divided into three-hour-per-week pieces. At the beginning of each semester every student would select five of these courses as far as possible on his own initiative.

Another possibility of this scheme might be of considerable significance. It concerns the number of courses for which a student would be permitted to register. When a student matriculates at the college he should be advised to register for five courses. If he shows poor scholarship during the first semester he should not be permitted to register for more than four courses the second semester. If he fails to maintain good scholarship with this lighter load he should not be allowed to register for more than three courses in the third semester. Some reasonable minimum limit might be set such as three courses. If he fails to do that much well he might be dropped. On the other hand, if he does exceptionally good work during his first semester of residence he should be permitted to register for six courses the second semester and if he does exceptionally well with that he might even perhaps be allowed to register for seven courses the third semester. This would give a range of from nine to twenty-one recitation hours per week or their equivalent to take care of the wide range in the abilities of the students.

The advantage with the variable load would be that the bright student could obtain his degree in less than four years while the slow student would be enabled to attain it in five years. The degree should be awarded as soon as the student has attained the required number of credits in each of the major fields listed for his degree.

This plan would give to the student an immediate incentive for good work. His good scholarship would be rewarded in an immediate and tangible way. His efforts would give him faster progress through his course. This is a more vital incentive than high scholarship marks on the registrar's books.

The keystone of this scheme is in the division of the degree curriculum into units of three hours per week. All courses taught in the college should be multiples of this unit.

The advantages of this plan would be briefly as follows:

1. The student acts as a responsible individual in selecting his courses for a definite end, the degree.

2. The irregular student would not cause as much administrative difficulty as under the rigid curriculum.

3. A non-degree student might pursue courses without upsetting the administrative machinery or the teaching in the college.

4. Good scholarship would be rewarded by faster progress toward the degree. This is a normal and healthy incentive for the student who is ambitious to enter a profession.

5. The schedule problems would be considerably simplified.

6. The slow student would be given a chance to find himself by a lighter load. He might return to the normal load after a year or two.

7. The student who finds it necessary to earn his expenses could do so without serious difficulty by carrying fewer courses. He would meet regularly in those classes which he elects to pursue. He could regulate the speed of progress from one semester to the next in accordance with the time that he will have available for study.

8. This plan would favor the stabilizing of courses of instruction.

9. It would be possible by this plan to admit students at the mid-year examinations without upsetting the administration.

It may be found that this plan would be more expensive to run than the regular curriculum. It seems to me, however, that if we have a certain number of students in the college and

a certain number of instructors, it should be possible to arrange the instruction by the plan here discussed perhaps as readily as by the rigid curriculum. We now must take care of students who fall behind in the academic lock step. This is done by special trailer classes. This expense should be taken into account in a comparison between the plans. There seems little doubt that this plan would eliminate much of the difficulty with schedule making and record keeping. From the standpoint of the student, the plan here discussed would be more normal and more flexible than the rigid sequence of a curriculum filled with courses of unequal size. There is nothing new in the plan that I have here discussed. My purpose is simply to call attention to the fact that this plan would solve many of the administrative problems in a professional school.

A COURSE IN ENGINEERING LITERATURE.

BY W. OTTO BIRK,

Assistant Professor of English, University of Colorado.

Of late much has been said about the necessity of providing the engineering student with more of the so-called "broadening" courses. All courses undoubtedly can be "broadening" if the instructor is broad. In other words, a course is just as broad as is the instructor's ability to present it. But even with the proper kind of instructor, it is unquestionable that some courses stimulate more breadth of thought than others. With this idea in mind, and also for the purpose of providing good examples of writing, the department of engineering English of the University of Colorado gives to all freshmen a required two-hour course in engineering literature. This course is poorly named, perhaps, because it does not deal chiefly with problems of engineering. It is rather concerned with the many aspects of the life and work of the engineer. The discussion, therefore, embraces many subjects, including economics, social science, philosophy, religion, literature of all ages, and pure and applied science. Obviously, the course is extensive rather than intensive. No attempt is made to study these subjects thoroughly; they are referred to only when suggested in relation to the specific problem under consideration. The suggestions, to be sure, are directed by the instructor. Any charge of superficiality is defended with the hope that the students may be encouraged to undertake of their own accord a study of these subjects. Furthermore, one of the primary objects of the course should be borne in mind; to lead the student into various paths of thought and thereby broaden his outlook.

Other similar courses, to be sure, have been devised. The difference between them is not one of purpose, but of methods. The methods of this course, however, may be somewhat differ-

ent because the aim is also slightly different. Altogether, it has the following five-fold object:

1. To broaden the student's horizon of thought.
2. To teach him how to use the library efficiently.
3. To give him practice in addressing an audience.
4. To acquaint him with the literature pertaining to his own subject.
5. To teach him how to write by showing him how others have written.

Though these aims are widely separated, they are easily and naturally coördinated. In the first place, the course is given unity by using as a basis a collection of readings. Two days are given to each selection: one to a study of the thought, primarily, and one to the structure—insofar as it is possible to disengage the two. Each selection deals with some phase of engineering or science, but the treatment is broad enough so that numerous opportunities are given in the discussions to branch out into many subjects.

All of these side-lights, however, are not generated in class, for some of the subjects suggested in the selections are so big that they demand more than casual mention. Accordingly, one of these topics is assigned to each member of the class in the beginning of the course. Papers are prepared on these topics, and, at the proper time, they are read by the students before the class. As an average, three papers are read at each meeting. These require about half of the class period. The remaining time is given to a discussion of the selection. The following list will give some idea of the diversity of the subjects treated. It should be remembered that all of them have a definite relation to one or another of the selections from the book of readings:

The Development in This Country of the Aniline Dye Industry.
Who was Aristotle?
Opinion of Engineers Regarding a More Liberal Education of Men of Their Profession.
The Scope of the Study of Economics.

A Brief Biography of William Froude.
The Development of the Concrete Ship.
Who was Ptolemy and What Contributions Did He Make to Mathematics?
A Brief Account of Greek Mythology.
Witchcraft as Practised by the Puritan Fathers.
Chief Characters and Events of the Victorian Epoch.
Instances of Successful Utilization of Water Power.
Important Grecian Sculpture.
The Story of Brooklyn Bridge.
A Biographical Sketch of Rudyard Kipling.
The Story and Significance of the "Ancient Mariner."
The Various Accomplishments of F. Hopkinson Smith.

It can readily be seen that, since the instructor supplies none of the information for these papers, the student must have some knowledge of the source of material. For this reason the first two class periods are given over to instruction in the organization and use of the library. In the beginning, too, a proper value is placed upon this kind of work. The student is given to understand that he is merely compiling information, and that the only originality in the work is his organization and presentation of this information. In order to stimulate a proper attitude in this respect, a complete bibliography is demanded with each paper.

The readings that make up the basis of the course deal with science and engineering instead of more general topics because the general appeal of these subjects furnishes a better starting point. It is usually recognized that most beginning engineering students think that they are exceedingly practical and must study nothing that does not bear directly upon engineering. The first aim of the instructor, to be sure, is to lead the student away from this attitude, but better results can be gained by meeting it with toleration than with opposition. Because of this same peculiarity, the course is given in the spring term of the freshman year, after much of the dislike of everything non-technical has had a chance to wear away. Though some students, unfortunately, never lose this attitude, two years of teaching this course have disclosed that few remain antago-

nistic if not antagonized, and that many become enthusiastic enough to write more papers than are required, merely to extend their knowledge of a certain subject. The majority soon realize that the engineer's outlook upon life must be as broad as that of any professional man; and that the efficient use of the library and the ability to address an audience are essential to his highest professional attainments. Furthermore, he learns by studying the examples of others how to express himself more effectively.

FROM THE NOTEBOOK OF AN ENGINEER. IV.

BY R. FLEMING,

American Bridge Co., New York City.

What does the technical college owe to the community in which it is located? Two years ago a 2,300,000-gallon molasses tank in the City of Boston collapsed with attendant loss of life to many, injury to others and much damage to near-by property. The Municipal Court investigation brought out that the tank was woefully lacking in structural strength and had but little, if any, factor of safety though near a busy city street. (See *Engineering News-Record*, Feb 13, 1919, p. 353 and May 15, 1919, p. 974.)

Within three miles from the site of the tank there is located one of the leading technical colleges in the United States. Is it, or is it not strange, that the failure of this tank, so palpably weak in design, was not foreseen by professor, instructor or student in said college? If it had been an ordinary water tank a negative answer could be given. But this tank was phenomenal, 90 ft. in diameter, 50 ft. high, a capacity of over 2,000,000 gallons, and used for molasses which is 44 per cent. heavier than water. It seems to an outsider that some enterprising student would have investigated the tank out of curiosity even though no suggestion to do so had been given by an instructor. But of professors, instructors and students, like the chickens of Isaiah, "there was none that moved the wing, or opened the mouth, or peeped." May not the foregoing be considered a specific case of neglect of duty by a college to its community?

Cases of general neglect are often found in the matter of building codes. It might be supposed that the seats of technical institutions would have model building codes. How far this is from being the case let any professor of engineering who reads these lines judge for himself by examining

the code of his own city. How many teachers of engineering have ever written or spoken of a building code? And yet the great majority of steel frame buildings are supposed to be constructed in accordance with some local building code. Professor Young's articles, "The Structural Requirements of the Toronto Building By-Law of 1913" (*Canadian Engineer*, Feb. 26, 1914) and "Reduction of Girder and Column Live Loads" (*Canadian Engineer*, Dec. 2, 1920), are fine examples of constructive criticism, but such articles are rare. Often the college library does not possess the latest code of its own city. Let the professor of engineering look over the shelves and feed his sense of humor on what he finds. Usually it will be a few miscellaneous codes from five to thirty years old. To come back to Boston! Its building code contained until 1919 the absurd provision that office floors should be designed for a live load of 100 lb. per sq. ft. of area and the meaningless sentence, "Provision for wind bracing shall be made wherever it is necessary." The first requirement put the builder to needless expense, the second did not properly safeguard life and property. Similar requirements are still in the building codes of Cambridge and other neighboring cities. Paragraphs from the codes of other cities having technical institutions within their borders may be equally criticized. Are the engineering faculties of these institutions doing anything to have these faults remedied?

It is only fair to state that many universities and technical colleges are rendering service in good measure to their respective communities.

Does the college owe anything to the community at large in what may be called the "popularization" of knowledge? By "popular" is meant the dictionary definition, "of or pertaining to the people at large," and also that the knowledge or information imparted be in language that can be understood by the people at large. A reformer need not be disagreeable though he often is, a professor need not be un-

interesting in the presentation of facts though he often is. A class of girls in a certain Sunday School was the despair of the superintendent. There were twelve of them, simple, ignorant, giggling girls. No teacher remained with them more than a month, seldom more than two weeks. One Sunday just before the lesson hour the superintendent brought to the class a man past fifty, unprepossessing in his looks and not very well dressed. He introduced him and then retreated. The girls looked at the man and the man looked at the girls. He began, "I wonder how many of you girls have got a beau." He had their attention at once and he kept it. After the session the superintendent said to the teacher, "Jones, what did you do to those girls, did you hypnotize them?" "No," was the reply, "I got down to where they lived." And that is just what many a college professor in talks to an audience fails to do. He shoots over their heads.

The college professor is seldom a success as a magazine writer even on subjects in which he may be a recognized authority. Lyman Abbott in his "Reminiscences" tells a story of unusual interest. One of the Harpers had asked him to write an article for the *Magazine* on ocean steamship travel. He excused himself because he had no knowledge of the subject except that gained from a single voyage across the ocean. "Then ask your father to write it." This he did.

"Why do you not write the article yourself?" asked my father.

"Because I know nothing of the subject," was my reply.

"Then," said he, "you are just the one to write it."

"How is that?" I asked.

"Because," said he, "the object of the author of a popular magazine article is to give knowledge of a subject to people who are wholly ignorant of it. To do that he must know both the subject and the condition of ignorance. If he is familiar with the condition of ignorance, he can make himself acquainted with the subject; but if he is thoroughly

familiar with the subject it is almost impossible for him to acquaint himself with the condition of ignorance." This principle, laid down by his father, Lyman Abbott says became his guide when he took up editorial work. "I have found it almost uniformly true that an expert cannot write on the subject with which he is familiar what readers who are not familiar with the subject can understand. The experienced but non-technical writer must provide the article, and it must then be submitted to the expert to make sure that he has fallen into no serious errors."

A rule that all technical writers should keep in mind is, "Never write a sentence to show how much you know." With a profound knowledge of a subject this is hard to follow. Instead of keeping in mind the ignorance of the reader and his needs the writer often goes out of the way to exhibit his own knowledge.

Professor ———— tells how he once wrote a book for a correspondence school. In it he noted that an engineer is often called upon to use good judgment as well as formula. The president of the school insisted that this part be taken out. "Correspondence school engineers," he said, "are not supposed to use judgment."

It is not here intended to put a premium upon ignorance. One of the chapters in Fielding's "Tom Jones" has for a title, "An essay to prove that an author will write the better for having some knowledge of the subject on which he writes." The statement is undeniably true.

"Many lecturers and professors have been surprised by the knowledge that they have from their students; sometimes they have been scared by it," says Professor Andrews, an author and teacher of no mean repute. He relates a story that Professor Kennedy tells of how he took a class one year in structural theory and how they went laboriously through all the various bending-moment diagrams, graphical methods, etc., and in the end he set them a very simple examination. One of the questions was, "What is the bending moment of

a beam?" He learned from one of his students that "the bending moment of a beam is the moment when it breaks." He learned from another who was asked to define the function of the flanges of a beam that "the function of the flanges of a beam are the ends upon which they are supported."

The mental attitude of a professor towards the student has an important bearing not only upon the life of the student but also upon the community. This mental attitude is gauged more accurately than the professor is aware. Three or four summers ago two professors planned to spend their vacation "near to nature" and chose a farm in New Hampshire, miles from a railroad station and "far from the madding crowd." They became sick of their choice on the day of their arrival. "Well," said one to the other the next morning, "thank God, there is not an undergraduate within ten miles." It is respectfully submitted whether the mental attitude betrayed by that professor's outburst of thanksgiving was not a handicap to his usefulness.

The charge has been brought that many technical colleges are become merely feeders to great corporations. The gentleman who at a banquet sat next to a high official of one of our largest corporations says that he asked him about their employment of college students and where they obtained the best men. "Well," the official replied, "we employ a great many. The best men do not come from Yale or Cornell or the University of Michigan but from ————. The men from this institution are head and shoulders above those from any other." To the writer this is no evidence that the institution so highly rated was at all head and shoulders above the other named. It may have been only a feeder to a great corporation to the real detriment of many of its students. The technical college owes more to the community at large than furnishing men specially trained for the needs of a great corporation.